DAVINCI MEDICAL ACADEMY

SUBJECTS IN NUTSHELL FOR EFFECTIVE REVISION

ANATOMY IN NUTSHELL

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ELITE TEAM OF FACULTY

SOME OF OUR FMGE TOPPERS

DMA'S CORNER OF WISDOM

EMBRYOLOGY

GAMETOGENESIS

FERTILIZATION

- Process by which spermatozoon from the male and the oocyte from the female unite to give rise to a new organism- **ZYGOTE**
- Male and female germ cells undergo a number of changes involving chromosomes and cytoplasm
  1. To reduce the number of chromosomes to half, i.e. from 46 to 23 (meiotic or maturation divisions)
  2. To alter the shape of germ cells in preparation for fertilization.Male germ cell develops a head,neck and tail (loses cytoplasm) Female germ cell becomes larger (inc. cytoplasm)
- Human somatic cell contains 23 pairs ora diploid number of chromosomes (one the other, other is from the father)

MITOTIC DIVISION

- **Before mitosis, each chromosome replicates DNA-become doubled**
  - Chromosome begin to coil, contract, and condense but the two paired subunit (chromatids) still cannot be recognized.
  - **prometaphase-** chromosomes become compact rods, chromatids distinguishable.
  - **metaphase**- line up in the equatorial plane, double structure is clearly visible.
  - **anaphase and telophase**-chromosome undergoes longitudinal division of the centromere and separates
  - into two **daughter** chromosomes which migrate to opposite poles of the cell.
  - Each daughter cell receives one half of all the doubled chromosome material thus maintains the same
  - number of chromosomes as the mother cell.

MEIOTIC DIVISION

- Primitive germ cells replicate their DNA just before first meiotic division begins

FIRST MEIOTIC DIVISION

- Germ cells contain double the normal amount of DNA (4n)
- Each of the 46 chromosomes is a double structure
- **Pairing of the homologous chromosomes**
  1. Exact and point for point
  2. centromere do not pair
  3. each contain two chromatids---

so homologous pair has 4 chromatids

- **interchange of chromatid segments** bet, two paired homologous chromosomes **(cross over)**
- **Chiasma formation**–X appearance in the chromosomal structure- blocks of genes are exchanged between homologous chromosomes
- **pulling apart of doubled structure chromosomes**
- **migration to opposite poles**

SECOND MEIOTIC DIVISION

- 23 double- structured chromosomes divide at the centromere
- each of the newly formed daughter cells receives 23 chromatids---haploid wherein the DNA content is half that of the normal somatic cell.

Results of meiotic division:

1. one primary oocyte gives rise to four daughter cells---each with 22+1 X- chromosomes (only one develops into a mature gamete, the OOCYTE; the other three , the polar bodies , degenerate.
2. primary spermatocyte gives rise to 4 daughter cells: two with 22 + 1 X chromosomes,and two with 22 + 1Y- chromosomes.

Abnormal meiotic division:

1. **Nondisjunction-** failure to separate, occurs on the meiotic division of the female germ cells.
2. **trisomy** – 47 chromosomes
3. **monosomy** – 45 chromosomes

DMA'S CORNER OF WISDOM

MORPHOLOGICAL CHANGES DURING MATURATION

PRIMORDIAL GERM CELLS

- appear in the wall of the yolk sac at the end of the third week of development
- migrate by amoeboid movement towards the developing gonads (primitive sex glands)
- arrive at the end of 4th or the beginning of 5th week

OOGENESIS

I. Prenatal maturation

- **Oogonia** – derived from primordial germ cell
  - undergo mitotic divisions
  - arranged in clusters by the end of 3rd month
  - surrounded by a layer of flat epithelial cells
  - some differentiate into larger **primary oocytes that will enter to the prophase of first meiotic division**
  - **fifth month**- maximum number of germ cells (7,000,000)
  - **seventh month**- majority of the oogonia have degenerated
  - **PRIMORDIAL FOLLICLE—** surviving primary oocyte together with its surrounding flat epithelial cells

II. POSTNATAL MATURATION

- **dictyotene stage**- a resting stage during prophase characterized by a lacy network of chromatin.
- **Primary oocytes remain in prophase and do not finish their first meiotic division before puberty is reached** due to OOCYTE MATURATION INHIBITION (OMI)
- At puberty, number of primordial follicles begin to mature with each ovarian cycle.
- **PRIMARY FOLLICLE** –Primary oocyte (still in dictyotene stage) begins to increase in size, and flat epithelial cells change to cuboidal.
- **ZONA PELLUCIDA-** formed by thickened acellular material consisting mucopolyssacharides deposited on the surface of the oocyte
- **FOLLICULAR ANTRUM-** formed by coalition of fluid- filled spaces appearbetween the follicular cells
- **CUMULUS OOPHORUS-** follicular cells surrounding the oocyte remain intact.
- At maturity, follicle is known as the**tertiary or vesicular follicle,** that is surrounded by:
  1. **theca interna thecal gland** – cellular ,rich in bllod vessels, main source of estrogen
  2. **theca externa**–merges with the ovarian stroma, fibrous

SPERMATOGENESIS

- differentiation of germ cells in male begin at puberty
- **sustentacular or sertoli cells**
- before puberty, the sex cords of the testis acquire a lumen and become **seminiferous tubules**

Primordial germ cell

- **spermatogonia**
- **primary spermatocytes** (cells start with prophase of 1st meiotic division- lasted for 16 days)
- **secondary spermatocytes**(second maturation or meiotic division result to production of **2 spermatids**, eachcontaining **23 chromosomes** and **n amount of DNA**)

SPERMIOGENESIS

- spermatids undergo series of changes resulting to production of **spermatozoa Changes are:**
  1. formation of the acrosome, extends half the nuclear surface
  2. condensation of the nucleus
  3. formation of neck, middle piece, and tail
  4. shedding of most of the cytoplasm
- 61 days- time required for a spermatogonium to develop into a mature spermatozoon
- Spermatozoa when fully formed, enter the lumen of seminiferous tubules
- Pushed toward the epididynis by the contractile elements in the wall of seminiferous tubules
- **Obtain full motility in the epididymis**

- Pharyngeal arches are rod-like thickenings of mesoderm present in the wall of the foregut.
- In the interval between any two arches, the endoderm is pushed outwards to form endodermal or pharyngeal pouches.
- Opposite each pouch, the surface ectoderm dips inwards an ectodermal cleft. So,
  - ★ Arch → Mesoderm;
  - ★ Pouch → Endoderm;
  - ★ Cleft → Ectoderm

OVULATION to IMPLANTATION (First Week of Development)

Ovarian Cycle

- Sexual Cycles
  - Starts at puberty
  - Regular monthly cycle
  - Controlled by hypothalamus

- Hypothalamus produce releasing factors act on cells of pituitary gland secrete gonadotropins:
  - Follicle Stimulating Hormone (FSH)
  - Luteinizing Hormone (LH)

- At the start of each ovarian cycle 5-12 primordianfollicles begin to grow under influence of
- Follicle stimulating hormone.
- Under normal conditions only one follicle reaches maturation and only one oocyte is discharged
- The others degenerate and become atretic, so the majority of follicles degenerate w/o reaching maturity
- When the follicle becomes atretic, the oocyte andsurrounding follicular cells degenerate and are placed by connective tissue forming **Corpus Atreticum**
- During growth of follicle, large numbers of follicle and theca cells are formed which produce
- estrogens (stimulate pituitary gland to secrete luteinizing hormone)
- **LH is needed for:**
  - ✓ Final stage of follicle maturation
  - ✓ Induce shedding of the oocyte **OVULATION**

OVULATION

- Days immediately before ovulation, the GraafianFollicle increases rapidly in size under influence of FSH and LH (15 mm diameter)
- Primary oocyte, which until this time has remainedin its dictyotene stage,resumes and finishes its 1st meiotic division.
- Surface of ovary begins to bulge locally and at the apex, an avascular spot appears **STIGMA** Result of local weakening and degeneration of the ovarian surface, follicular fluid oozes out Through the stigma w/c gradually opens.
- When more fluid escape, the tension in the follicle is released, with the oocyte and surrounding Cumulus oophorus cells break free and float out of the ovary Some cumulus oophorus rearrange around the Zona pellucida to form **CORONA RADIATA**
- **Ovulation** – the moment the oocyte and its cumulus oophorus cells discharge from the ovary, the first meiotic division is completed and secondary oocyte is starting its 2nd meiotic division.
- Middle Pain – pain occurring near the middle of the menstrual cycle. Rise **in BASAL BODY TEMPERATURE** aid in determining when release of oocyte occurs.

CORPUS LUTEUM

- After ovulation the follicular cells remaining in the wall of ruptured follicle are vascularized by surrounding vessels and become polyhedral.Under influence of **LH** it will develop yellowish pigment and change into **LUTEAL CELLS** forms **CORPUS LUTEUM** and secrete progesterone
- **PROGESTERONE** with estrogenic hormones of theca cells causes uterine mucosa to enter the **PROGESTATIONAL SECRETORY STAGE** in preparation for implantation of the embryo.

OOCYTE TRANSPORT

- Before ovulation, the fimbriae of the oviduct begin to cover the surface of the ovary and the tube itself begins to contract rhythmically Oocyte and surrounding cumulus/granulosa cells is carried into the tube by sweeping movements of the fimbriae and by the motion of cilia on the epithelial lining.
- Once in tube the cumulus cells lose contact with oocyte by withdrawing their cytoplasmic process from zona pellucida. Once oocyte is in uterine tube, it is pushed toward the lumen by the contractions of muscular wall.
- Fertilized oocyte reaches uterine lumen in 3- 4 days.

CORPUS ALBICANS

- If fertilization fails to occur, corpus luteum reaches maximum development about 9 days after ovulation Corpus luteum decreases in size through degeneration of the luteal cells and forms a mass fibrotic scar tissue **CORPUS ALBICANS** Progesterone production decrease,precipitating menstrual bleeding.
- If oocyte is fertilized, degeneration of corpus luteum is prevented by the gonadotropic hormone secreted by the trophoblast of developing embryo.
- Corpus luteum continues to grow and forms **CORPUS LUTEUM of PREGANANCY** (gravidities)
- At the end of 3rd month the structure is 1/3 to ½ of the total size of the ovary Yellowish luteal Cells continue to secrete progesterone until end of 4th month, then regress slowly as secretio of progesterone becomes adequate for maintenance of pregnancy
- Removal of corpus luteum if pregnancy before 4th month usually leads to abortion
- Progestational compound taken orally form day 5 to 25 of menstrual cycle usually act as Contraceptives and inhibit ovulation almost 100% of the cases.

FERTILIZATION

- Process by w/c male and female gametes fuse,itoccurs in ampullary region of uterine tube, the widest part of the tube and located near the ovary.
- Spermatozoa can stay alive in female reproductive tract for 24 hours, secondary oocyte dies 12 to 14 hours after ovulation if not fertilized.
- Rapid passage of spermatozoa in the vagina intouterus into uterine tubes is caused by Contractions of the muscle
- Spermatozoa can't fertilize oocyte unless they undergo:
  - **CAPACITATION** – period of conditioning in the female reproductive tract (7hours).A glycoprotein coat and seminal plasma proteins are removed from plasma membrane that overlies acrosomal region. Completion permits acrosome reaction.
  - **ACROSOME REACTION** –occurs in immediate vicinity of oocyte under influence of substance from corona radiata and oocytes.During this process the ff are released:
    - ✓ Hyaluronidase – needed to penetrate corona radiata barrier
    - ✓ Trypsin-like substance – digestion of zona pellucida
    - ✓ Zona lysine – help spermatozoon cross zona pellucida

IN VITRO FERTILIZATION

- Follicle growth is stimulated in the ovary by administration of gonadotropins:
  - ✓ hMG = stimulate growth
  - ✓ hCG = induce preovulatory changes
- In vitro provides opportunity to alleviate infertility from variety of causes including occluded Oviducts hostile cervical mucus, immunity to spermatozoa,etc.
- Risk of producing malformed offspring is low due tohigh resistant of preimplantic embryo to teratogens. Low success rate since only 20% of fertilized ova implant and develop to term.

ALTERNATIVE TO NORMAL FERTILIZATION

SUPERFECUNDATION

- Polyovulation wherein one or more oocyte released in a given ovarian cycle are fertilized by spermatozoa from male and another oocyte is fertilized by different male

PARTHENOGENESIS

- Female gamete can't produce embryo w/o male gamete, occasionally the oocyte is activated w/o sperm.

DMA'S CORNER OF WISDOM

ABNORMAL ZYGOTES

- shows multinucleated blastomeres
- variable degree of degeneration
- Self-cleaning or spontaneous abortion wherein abnormal zygotes are lost during early stages w/o the mother being aware of it

UTERUS AT TIME OF IMPLANTATION

- 3 layers of uterus wall:
  - ✓ endometrium or mucosa lining the inside wall
  - ✓ myometrium, thick layer of smooth muscle
  - ✓ perimetrium, peritoneal covering lining the outside wall
  - ✓ At time of implantation the mucosa of the uterus is in the secretory or progestational phase. It is caused by the progesterone secreted by corpus luteum.
- **Signs:** uterine glands and arteries become coiled and the tissue become succulent, as a Result layers are recognized in the endometrium:
  - ✓ superficial compact layer
  - ✓ intermediate spongy layer
  - ✓ thin basal layer
- if oocyte is fertilized, the glands in the endometrium show increasing secretory activity and the arteries become tortuous and form a dense capillary bed beneath the surface. As a result the endometrium becomes highly edematous.
- If oocyte is not fertilized, the venules and sinusoidal spaces become gradually packed with blood cells and an extensive diapedesis of blood into the tissue is seen.
- Menstrual phase, blood from superficial arteries and small pieces of stroma and glands break away. During 3 or 4 days the compact and spongy layers are expelled and the basal layer is the only part retained in the endometrium.Basal layer is supplied by its own arteries,basal arteries, and functions as the regenerative layer in the rebuilding of glands and arteries in proliferative phase.

ABNORMAL IMPLANTATION SITES

- Human blastocyst usually implants along the posterior or anterior wall of the body of uterus.Sometimes implantation sites are found outside the uterus resulting in **EXTRAUTERINE or ECTOPIC PREGANANCY.**
- This may occur at any place in the abdominal cavity, ovary, uterine tube. Ectopic pregnancy usually leads to death of embryo and sever hemorrhaging during 2nd month.
- In the abdominal cavity the blastocyst most frequently attaches itself to the peritoneal lining of the **RECTOUTERINE CAVITY or DOUGLAS' POUCH.**
- Sometimes blastocyst develops in the ovary proper causing **a PRIMARY OVARIAN PREGNANCY**. More commonly at ectopic pregnancy is lodged in uterine tube **(TUBAL PREGANANCY).**

FETAL MEMBRANES AND PLACENTA

- Trophoblast – characterized by a great no. of secondary and tertiary villi giving it a radial appearance
- Villi – anchored in the mesoderm of the chorionic plate
- Attached peripherally to the maternal decidua via the cytotrophoblast shell
- Its surface is formed by the syncytium on a layer of cytotrophoblastic cells
- Cytotrophoblastic cell – cover a core of vascular mesoderm
- Formation of the extramembrane vascular system capillary system developing in the core of the villous stem comes in contact with capillaries of the chorionic plate and connecting stalk
- Numerous small extensions sprout from existing villous stems into the lacunar or intervillous spaces
- The syncytium and Endothelial wall of the blood vessels the only layers separate the maternal and fetal circulations
- Syncytial knots broken off pieces of syncytium a nuclei may break off into the intervillous Blood lakes enter maternal circulate degenerate without causing symptoms
- Disappearance of cytotrophoblastic cells progress from the smaller to larger villi some persist in large villa don't participate in plate exchange

CHORION FRONDOSUM and DECIDUA BASALIS

- In the early weeks of development, villi cover the entire surface of the chorion
- Villi on embryonic pole will continue to grow and expand **CHORION FRONDOSUM** (bushy chorion)
- Villi on the abembryonic pole degenerate 3rd month, it will become smooth **CHORION LAEVAE**
- The decidua, the functional layer of the endometrium is shed during parturition
- Decidua basalis decidua over the chorion frondosum a compact layer of the large cells
- deciduals cells with abundant amounts of lipid and glycogen
- Decidua plate – tightly connected to the chorion
- Decidua capsularis – decidual layer over the abembryonic pole will become stretched and later degenerates because of the increase in size of the chorionic vesicle
- Chorion laevae comes into contact with the uterine wall **(DECIDUA PARIETALIS)** on the Opposite side of the uterus fuse obliterate uterine lumen (only the portion of the chorion participating in exchange process is the chorion frondosum)
- Placenta – chorion frondosum + decidua basalis
- Amnochorionic membrane fusion of the amnion and chorion
- Ruptures during labor, breaking of the **H20**

STRUCTURES OF THE PLACENTA

- By 4th month placenta has:
  - ✓ fetal portion formed by the chorion frondosum
  - ✓ maternal portion decidua basalis
- fetal side - border: chorionic plate
- maternal side – border: decidua basalis of which the decidual late (most intimately incorporated into the placenta)
- junctional zone – where the trophoblast and decidua cells intermingle characterized decidual and syncitial giant cells is rich in amorphous extracellular material
- Most of the cytotrophoblast have degenerated
- Intervillous space filled w/ maternal blood derived from lacunae in the syncitiotrophoblast lined with syncitium of fetal origin
- Villous trees grow into intervillous blood lakes
- 4th or 5th month, decidua forms a number of septa = decidual septa
- decidual septa projects into the intervillous spaces but not reach the chorionic plate core: maternal tissue surface is covered by a layer of syncitial cells
- at all times a syncitial layer separates maternal blood in the intervillous lakes form fetal tissue Of the villi
- placenta is divided into a number of com0artments or cotyledons
- placenta enlarges and the uterus expand
- its increase in the surface are parallels the uterus, covering 15-30%of internal surface of the uterus
- increase of thickness is a result of arborization of existing villi and not further penetration

FULL TERM PLACENTA

- discoid shape
- 15-25 cm diameter, 3 cm thick
- weight: 500-600 gm
- torn from the uterine wall 30 mins after birth of child it is expelled from the uterine cavity
- maternal side viewed:
  - ✓ 15-20 shortly bulging areas/cotyledons covered by a thin layer of decidua basalis.
  - ✓ grooves between cotyledons are formed by deciduals septa
  - ✓ much of the decidua remains temporarily in the uterus and is expelled w/ subsequent uterine bleedings
- fetal surface viewed:
  - ✓ covered by chorionic plate
  - ✓ chorionic vessels – large arteries and veins converging toward the umbilical cord
  - ✓ chorion is covered by amnion
- attachment of the umbilical cord usually is eccentric and occasionally even marginal
- rarely in velamentous insertion
- insertion into chorionic membranes outside the placenta

CIRCULATION of THE PLACENTA

- cotyledons receive their blood supply via 80-100 spiral arteries piercing the decidual plate and entering the intervillous spaced at regular intervals
- lumen of spiral artery is narrow an increased blood pressure when entering the intervillous pace
- this pressure forces the blood deep into the intervillous space and bathe the small villi of the villous tree in oxygenated blood
- as pressure decrease the blood flows back form the chorionic plate toward decidua and enter the endometrial veins
- Blood from the intervillous lakes drain into the maternal circulation through endometrial veins.
- Intervillous spaces of a mature placenta contain approximately 150 ml of blood that is Replenished abt 3-4 times /minute.
- Placental exchange does not take place in all villi, only those in which fetal vessels are in Intimate contact with the covering syncytial membrane – these villi have brush border Surfaces with numerous microvilli greatly increasing the surface area and exchange rate between maternal and fetal circulation.
- Placental membrane separates maternal and fetal blood composed of 4 layers:
  - ✓ endothelial lining of fetal vessels
  - ✓ connective tissue in the virus core
  - ✓ cytotrophoblastic layer
  - ✓ syncytium
- from the 4rt month on the placenta membranes become thinner since the endothelial living of the vessel comes in intimate contact with the syncytial membrane. Increasing rate of exchange.
- Placental barrier = not a true barrier since many substances pass thru it freely = hemochonial type

FUNCTIONS OF THE PLACENTA

- Exchange of metabolic & gaseous products between maternal & fetal blood stream.
- Production of hormones
- Exchange of gases O2, CO2, CO Simple diffusion Fetus extracts 20-30 ml of O2 per minute.Placenta blood flow is critical to O2 supply Amount of O2 reaching fetus dependent on delivery not diffusion
- Exchange of nutrients & electrolytes Amino acids, free patty acids carbohydrates & Vitamins Rapid Increases as pregnancy advances
- Transmission of maternal antibodies Maternal antibodies taken up by pinocytosis by syncytiotrophobast & transported to fetal capillaries Fetus acquires maternal antibodies of IgG is diptheria, measels, small pox Passive immunity important because fetus has little capacity to produce own RH Incompatibility Related to erythrocyte antigens Fetus (Rh +) is mother (Rh-) Fetal RBC invading maternal blood stream may elicit an antibody response in the mother Hemolytic disease of the newborn of fetal RBC – intra urine death Rh Ig given to mother
- Hormone production By end of 4th month, placenta produces progesterone to maintain pregnancy All hormones are synthesized in the syncytial trophoblast Produce increasing amounts of estrogenic hormones = estriol until just before the end of pregnancy – stimulate uterine growth and development of mammary gland Produce gonadotropins (hCG) Hormones are indicators of pregnancy Somatomammotropin – a growth hormone like substance that gives the fetus priorityon maternal blood glucose & makes mother diabetogenic

AMNION & UMBILICAL CORD

- Primitive umbilical ring – omnivectodermal junction– oval in shape
- At 5th week the following:
  1. connecting stalk – contain allantois and the umbllical vessels consisting of 2 arteries & 1 vein
  2. yolk stalk /vittelineduct – accompanied by vitlelineduct vessels.
  3. Canal connecting the intraembrayonic & extraembryonic coelomic cavities
- The yolk sac proper occupies a spree in the chronic cavity With further development, the amniotic cavity enlarges rapidly at the expense of the Chrorionic cavity – amnion regins to envelop the connecting and yolk stalks – leading to formation of primitive umbilical cord
- Distally, the cord contains: the yolk sac stalk 2 umbilical vessels
- Proximally: intestinal loops: remnant of allantois
- The yolk sac is found in the chronic cavity.Connected to the umbilical cord via its stalk
- By 3rd month, the chorionic cavity is obliterated, yolk sac shrinks and is also gradually obliterated.

- Physiological hernia of the umbilicus Due to the intestinal loops extending into the extracoelomic space because of a Small abdominal cavity – loops are withdrawn by the end of the 3rd month – coelismic cavity is obliterated
- The remaining umbilical vessels and cord are surrounded by jelly of Wharton
- Wharton's jelly –
  - ✓ tissue rich in proteoglycans-
  - ✓ function protective layer for blood vessels
- Walls of the vessels – arteries are muscular & contain many elastic Fibers –rapid construction.
- Amniotic bands
  - ✓ due to tearsin the amnion
  - ✓ encircle part of the fetus = digits & limbs
  - ✓ ring constrictions may result

PLACENTAL CHANGES AT THE END OF PREGNANCY

- increase in fibrous tissue in the core of the villus
- increase in the thickness of the basement membrane in fetal capillaries
- obliterative changes in small capillaries of the villi
- deposition of fibrinoid on the surface of the villi in the junctional zone & in the chorionic plate
- excessive fibrinoid formation – infarction –cotyledon appear whitish
- at birth, umbilical cord is 2 cm in diameter & 50- 60 cm long – may produce false knots.
- Short cords – difficulty in delivery long cords –encircle neck

AMNIOTIC FLUID

- Amniotic cavity is filled with a dear watery fund
- Produce by amniotic cells but derived primarily from maternal blood
- Amount increases from 30ml at 10 wks gestation to 350ml at 20 wks, 800-1000ml at 37 wks
- Functions
  - ✓ absorb jolt
  - ✓ prevent adherence of the embryo to the amnion
  - ✓ allow fetal movements
- Volume of fetal fund is replaced every 3 hors
- Fetus swallows its own amniotic fluid – drinking about 400 ml.day
- During childbirth, the amniochronic membrane forms a hydrostatic wedge that helps dilate The cervical canal.
- Oligohydramnios decreased amount <400ml of amniotic fluid can cause clubfoot & lung hypoplasia caused by renal agenesis
- hydramnios / poly hydramnios excess amniotic fluid caused by idiopathic causes, maternal diabetes congenital malformation, CIVS dis order, gastrointestinal defects.

FETAL MEMBRANE IN TWINS DIZYGOTIC TWINS / FRATERNAL

- incidence increased with maternal age result from simultaneous shedding of 2 octets &fertilization by 2 different spermatozoa Zygotes implant individually Develop own placenta, amnion, chorionic sac When too close together may fuse Possesses RBC of different types erythrocyte mosaicism)

MONOZYGOTIC TWINS

- Develop from a single fertilized ovum Twining rate: 3-4 /1000 Result from splitting of zygote at various stages of development
- Earliest separation at 2 cells stage Blastocyst implant separately Each has own placenta & chorionic sac Strong resemblance in blood groups, fingerprints, sex and external appearance
- Splitting of zygote occurs at early blaslocyst stage Inner cell mass splits into 2 separate groups of cells within the same blastocyst cavity 2 embryos have a common placenta and a common chorionic cavity but have separate amniotic cavities
- sometimes separation occurs at the bilaminar germ disc stage just before the appearance of the primitive streak – form 2 partners with single placenta, common chorionic & amnion sac have common placenta, blood supply is well balanced.
- Twin pregnancies have higher morbidity & a tendency toward preterm delivery Low birth weight Vanishing twin = death of one fetus

- ✓ usually in 1st or early 2nd trimester & fetus papyraceus
- ✓ Twin transfusion syndrome > 1 twin is larger that the other

- Conjoined siamese twins > incompletely separatedclassified as:
  - ✓ thoracophagus > fastened
  - ✓ pygopague
  - ✓ cramrophagus

FATE OFPHARYNGEALARCHES (Mesoderm)

- At first there are 6 arches. The 5th arch disappears and only 5 remain.

ARCH	NERVE	SKELETAL COMPONENT	MUSCLES OF THE ARCH
First Arch (Meckel's Cartilage)	Mandibular Nerve **Mandibular arch**	Malleus Incus Sphenomandibular lig. Anterior lig. of malleus	Mylohyoid Muscles of Mastication Anterior belly of digastric. Tensor Palatine Tensor tympani
Second Arch (Hyoid arch/ Richter's cartilage)	Facial Nerve	Stapes Styloid Process Stylohyoid ligament Smaller Cornu of hyoid Superior part of body of hyoid.	Stapedius, Stylohyoid Posterior belly of digastric. **Muscles of Facial expression**. Auricularis, Buccinator Frontalis, Platysma Orbicularis oris & Oculi
Third Arch	Glosso Pharyngeal Nerve	Greater Cornu of hyoid Lower Part of body of hyoid	Stylopharyngeus
Fourth Arch	Superior Laryngeal N(Vagus)	Cartilage of larynx	Constrictors of Pharynx Cricothyroid Levator Palatine
Sixth Arch	Recurrent Laryngeal N (Vagus)		Intrinsic muscles of larynx
Fifth Arch	**DISAPPEARS**		

FATE OF ENDODERMALPOUCHES

POUCH	FATE	
Ist Pouch	**Ventral Part**	Obliterated by formation of tongue
	Dorsal Part	Together with dorsal part of 2nd Pouch forms tubotympanic recess **Proximal Part** → Eustachian tube **Distal Part** → Middle ear cavity & tympanic antrum
IInd Pouch	**Ventral Part**	Tonsil
	Dorsal Part	Formation of tubotympanic recess
IIIrd Pouch		Thymus & Inferior Parathyroid glands
IVth Pouch		Thyroid (from thyro-glossal duct) Superior Parathyroid glands
Vth Pouch		Para - follicular (C-Cells) of thyroid from ultimo - bronchial body

FATE OFPHARYNGEALCLEFTS

PHARYNGEAL CLEFT	FATE
Ist	External auditory meatus & Ear drum
IInd IIIrd, IVth	Cervical sinus→ disappears; Sometimes persist as brachial cyst

SEX DIFFERENTIATION AND DEVELOPMENT:

- The Sex chromosomes: X and Y.
- Y chromosome- production of testes, the testis determining gene product is called SRY [Sex determining region of the Y chromosome] &Also has the gene for Mullerian Inhibiting Substance (MIS)

Development of the gonads:

On each side of the embryo, there is genital ridge
↓
Primitive gonad
↓
Gonad→ Cortex + Medulla

- In 7th week, the embryo has both male & female genital ducts.
- In normal female→ The mullerian duct system develops into uterine tubes and a uterus.
- In a normal male→ Wolffian duct develops into epididymis and vas deferens.
- In males, after 8 weeks, the medulla develops into testes and the cortex regresses.
- Leydig Cells and Sertoli cells appear, testosterone and MIS are secreted
- In females, the cortex develops into ovary & the medulla regresses.

FATE OF THE STRUCTURES DERIVED FROM UNDIFFERENTIATED GENITAL SYSTEM		
Structure	**Male derivative**	**Female derivative**
Gonad (Genital ridge)	Testis	Ovary
Sex Cords	Sertoli Cells Seminiferous tubules	Granulosa Cells
Primordial germ cells	Spermatozoa	Ova
Paramesonephric duct	Appendix of testis utricle of prostate	Uterine tube uterus upper vagina
Mesonephric duct	Appendix of epididymis, epididymis Ductus deferens Ejaculatory duct Seminal Vesicle	Appendix of ovary Gartner's duct
Mesonephric tubules	Vasa efferentia Paradidymis	Epoophoron Paroophoron
Genital tubercle	Penis	Clitoris
Genital Swellings	Scrotum	Labia majora
Urethral folds	Floor of penile urethra	Labia minora

- Mesonephric duct/ Wolffian duct is the main genital duct of males.
- Para - Mesonephric duct/ Mullerian duct is the main genital duct of females.

MESONEPHRIC / WOLFFIAN DUCT			
IN MALES		**IN FEMALES**	
Structures formed	**Remnants**	**Structures formed**	**Remnants**
1. Posterior wall of Prostatic Urethra 2. Ureteric buds forming ureter, Pelves, Calyces and Collecting duct **3. Trigone of bladder** 4. Appendix of epididymis 5. Ductus deferens 6. Epididymis 7. Ejaculatory ducts 8. Prostate 9. Seminal Vesicles	1. Superior aberrant tubule 2. Inferior aberrant tubule 3. Paradidymis	1.Posterior wall of female urethra 2.Ureteric bud forming ureter, Pelves, Calyces and collecting tubules 3.**Trigone of the bladder**	1.Paroophoron (Equivalent to paradidymis in males) 2.Epoophoron/ Gartner's duct (Equivalent to ducts deferens in males)

DMA'S CORNER OF WISDOM

PARAMESONEPHRIC / MULLERIAN DUCT	
Structures (In Females)	**Remnants (In males)**
Uterus Uterine tubes Part of Vagina	Appendix of testes Prostatic Utricle

DEVELOPMENT OF ALIMENTARY SYSTEM

Derivatives of Foregut	Derivatives of Midgut	Derivatives of Hindgut
○ -Part of the floor of the mouth, including tongue, Pharynx ○ -Thyroid and various derivatives of pharyngeal pouches ○ -Oesophagus, Stomach, Duodenum: Whole of the first part and upper half of the descending part (**upto the major duodenal papilla**) ○ -Liver and extra-hepatic biliary system, Pancreas, Respiratory system	○ -Duodenum: part distal to the major papilla ○ -Jejunum, Ileum ○ -Caecum, Appendix ○ -Ascending colon ○ -Right two-thirds of transverse colon	○ -Left one-third of transverse colon ○ -Descending & Sigmoid colon, Rectum ○ -Upper part of anal canal ○ -Parts of the urogenital system derived from the primitive urogenital sinus

DEVELOPMENT OF BLOOD VESSELS

- Common arterial trunk → Truncus arteriosus → six pairs of aortic arches appear (1st, 2nd and 5th arches disappear).

Third arch	Fourth arch		Sixth arch
	Right side	Left side	
Carotid Arteries	Brachiocephalic & Right subclavian.A	Aortic Arch & Left Subclavian.A	Right and Left Pulmonary arteries and ductus arteriosus

Embryological Structures	Adult derivatives
○ Truncus Arteriosus	Ascending Aorta
○ Aortic sac, Left 4th Aortic Arch	• Arch of Aorta
○ Left dorsal Aorta and fused dorsal Aorta	• Descending Aorta
○ Right Horn of Aortic sac	• Brachiocephalic.A
○ Right 4th Arch artery & 7th Cervical Intersegmental.A	• Right Subclavian.A
○ Left 7th Cervical Intersegmental.A	• Left Subclavian
○ Proximal Part of 3rd Arch Artery	• Common Carotid.A
○ Distal Part of 3rd Arch Artery and Cervical part of dorsal aorta	• Internal carotid artery
○ Bud from 3rd Arch Artery	• External Carotid artery
○ Truncus Arteriosus	• Pulmonary trunk
○ Part of 6th arch artery	• Pulmonary Artery
○ Part of left 6th arch artery between lung bud and aorta	• Ductus arteriosus

EVELOPMENT OF EYE

Structures developing from Ectoderm		Structures developing from mesoderm
Surface Ectoderm	**Neuro Ectoderm**	
• Conjunctival Epithelium • Corneal Epithelium • Lens • Lacrimal & Tarsal gland	• Epithelium of iris & Ciliary body • Muscles of Iris • Constrictor Pupillae • Dilator Pupillae • Retinal Pigment epithelium & its nine layers • Optic nerve	• Sclera • Corneal stroma & endothelium • Iris stroma & endothelium • Vitreous • Glial tissue of optic.N • All blood vessels of eye • All muscles except of iris • Trabecular mesh work

DMA'S CORNER OF WISDOM

DERIVATIVES OF ECTODERM:

Lining Epithelia	Glands	Others
• Skin & its Pigment cells • Mucus membranes • Lower part of anal canal • Terminal part of male urethra • Labia majora and outer labia minora • Anterior epithelium of Cornea, epithelium of Conjunctiva, Iris & ciliary body	○ **Exocrine:** • Sweat glands • Sebaceous glands • Parotid glands • Mammary glands • Lacrimal gland ○ **Endocrine** • Pituitary, Adrenal medulla	• Hair • Nails • Enamel of teeth • Lens of eye • + • All derivatives of neural crest

DERIVATIVES OF ENDODERM:

Epithelium	Glands
• Epithelium of part of mouth, palate,tongue,tonsil,pharnx and GIT upto upper part of anal canal • Epithelium of Eustachian tube, middle & Inner ear • Epithelium of Respiratory tract • Epithelium of gall bladder,extrahepatic ducts and pancreatic ducts • Epithelium of urinary bladder except trigone, female urethra except in its posterior wall, male urethra except in its posterior wall • Epithelium of greater part of Vagina, Vestibule and inner surface of labia minora	○ **Exocrine:** • Liver • Pancreas • Glands in walls of GIT • Prostate(except glandular Zone)

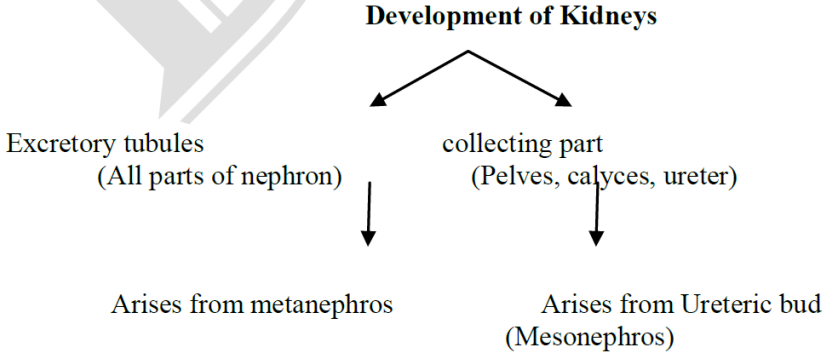
DERIVATIVES OF MESODERM

• All Connective tissues - fascia, tendons, ligaments • Dermis of skin • Adipose tissue, cartilage, Bone • Dentine of teeth • All muscles except that of iris • Heart, blood vessels, lymphatics	• Kidneys, Ureters, inner glandular zone of Prostate • Ovary, Uterus, Uterine tubes, vagina (upper part) • Adrenal Cortex • Testes, epididymis, ductus deferens, Seminal Vesicles and ejaculatory duct • Meninges & Microglia

DERIVATIVES OF MESOGASTRIUM

Dorsal mesogastrium	Ventral mesogastrium
○ Greater Omentum	• Lesser Omentum
○ Gastrosplenic ligament	• Falciform ligament
○ Gastrophrenic ligament	• Coronary ligament
○ LienoRenal ligament	• Right and left Triangular ligament

DEVELOPMENT OF KIDNEY



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Meckel's diverticulum

- Represents the persistent proximal part of the vitelline duct.
- It is present in 2% of population, situated in the **anti-mesenteric border**, usually 2 inches long & 2 feet from the Ileo-caecal valve. It has all the 3 coats of the intestinal wall & has its own blood supply.

Remnant of	Structure
○ Ductus arteriosus	→Ligamentum arteriosum
○ Ductus venosus	→Ligamentum venosum
○ Left umbilical vein	→Ligamentum teres of liver
○ Right umbilical vein	→Disappears
○ Vitello intestinal duct	→Meckel's diverticulum
○ Urachus	→Median umbilical ligament
○ Proximal part of umbilical A	→Superior vesical Artery
○ Distal part of umbilical A	→Lateral umbilical ligament
○ Left common cardinal vein	→Oblique vein of left atrium

NEURAL CREST

- During neural plate formation, some cells at the junction between the neural plate and the rest of the ectoderm become specialized to form neural crest
- These cells soon become free by losing the property of cell to cell adhesion and migrate to different parts of the body
- **Structures derived from neural crest**
  1. Neurons of the dorsal nerve root ganglia
  2. Neurons of the sensory ganglia of V, VII, VIII, IX & Xth Cranial nerves
  3. Neurons and satellite cells of sympathetic ganglia & the pre-aortic ganglia.
  4. Neurons and satellite cells of parasympathetic ganglia of cranial nerves.
  5. Parasympathetic ganglia of the GIT
  6. Schwann cells of all peripheral nerves
  7. Specific cells of the adrenal medulla
  8. Chromaffin tissue, Melanoblasts (Pigment cells) & Merkel cells of the skin
  9. Pia & Arachnoid mater
  10. Mesenchyme of dental Papilla, Odontoblasts and dentine
  11. C - Cells of the thyroid gland
- **Some diseases and syndromes associated disturbances in neural crest**
  - ✓ Hirchsprung's disease
  - ✓ Cardiac - septal defects (Aortico - Pulmonary)
  - ✓ Cleft - lip & Cleft palate
  - ✓ Fronto - nasal dysplasia
  - ✓ Neuro - fibromatosis
  - ✓ Tumours of adrenal medulla
  - ✓ Albinism.

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